NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

LIFE SCIENCES: PAPER I

MARKING GUIDELINES

Time: 2½ hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

Answer the questions in the spaces provided. Place this yellow booklet inside the Answer Book in which you answer the rest of the examination paper.

1.1 Select the term in the right column which best matches the description in the left column. Write the letter of the term in the corresponding space provided between the brackets. Use each letter only once.

	Description		**Term**
[L]	A unit of heredity composed of DNA.	A	chromatin
[H]	Half a chromosome, just prior to cell division.	B	recessive
[A]	This molecular complex, consisting largely of DNA and proteins can form thread-like structures.	C	genotype
[I]	This indicates that a cell has only one of each homologous pair of chromosomes.	D	dominant
[C]	This refers to the genetic makeup of an organism.	E	polyploid
[K]	This describes the chromosome number in a zygote after fertilisation.	F	phenotype
[G]	Alternate forms of a gene.	G	allele
[D]	This type of gene is often expressed in an organism.	H	chromatid
[B]	This type of gene is not expressed in a heterozygote.	I	haploid
[F]	Observable physical characteristics of an organism.	J	gamete
		K	diploid
		L	gene

(10)

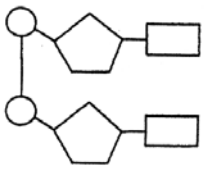
1.2 Six multiple choice questions are given below. Choose the most correct alternative in each question and write its letter in the space provided in the table.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6
Answer	**B**	**D**	**C**	**B**	**B**	**B**

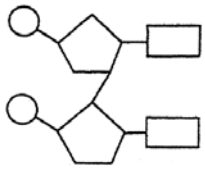
(6)

1.2.1 Which of the following diagrams shows nucleotides correctly joined together?

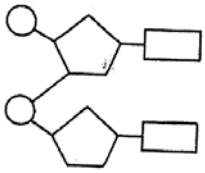
A



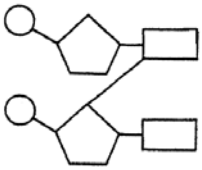
C



B



D



1.2.2 Which of the following is a base pair normally present in DNA?

A adenine and cytosine
B guanine and adenine
C thymine and guanine
D thymine and adenine

1.2.3 Refer to the table below to answer this question.

Cell type	**Average mass of DNA per cell ($\times 10^{-12}$)**
sperm	3.35
kidney	6.70
lung	6.70

The average mass of DNA present in an ovum of the species referred to in the table above would be …

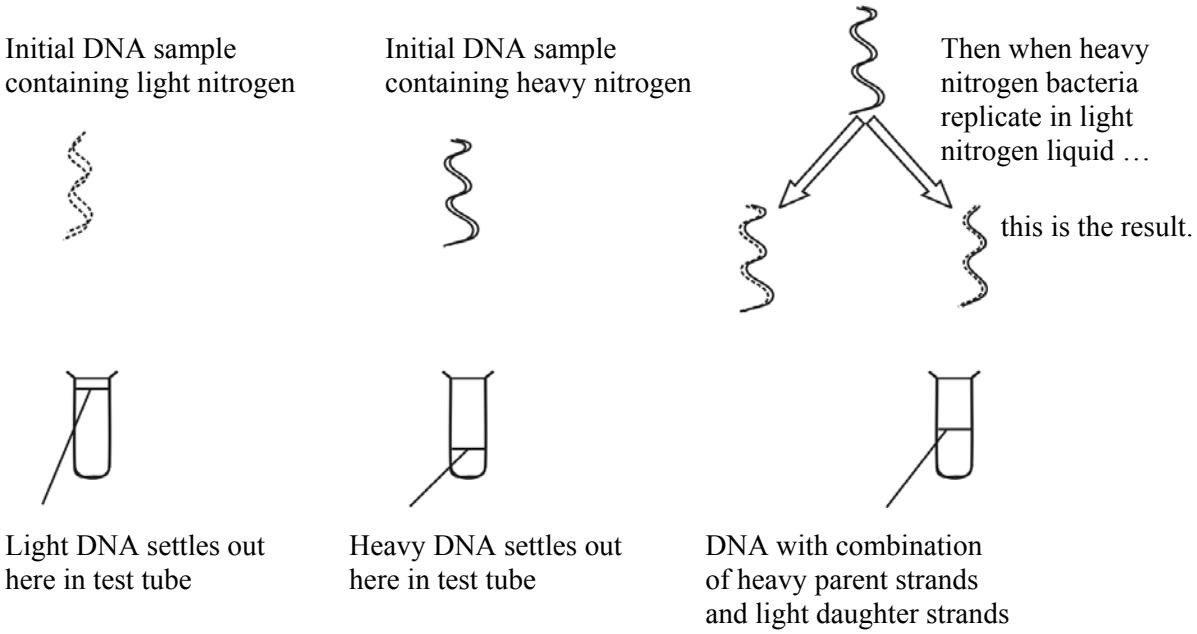
A 3.35×10^{-6}
B 6.70×10^{-6}
C 3.35×10^{-12}
D 6.70×10^{-12}

1.2.4 If 30% of the bases in a DNA molecule are adenine, what percentage of the bases are guanine?

A 15%
B 20%
C 30%
D 40%

Observe the following diagrams of the experiment that followed and use this to answer questions 1.2.5 and 1.2.6.

DNA replication can be shown by using two isotopes (radioactive markers) of nitrogen; 'light' nitrogen (^{14}N) and 'heavy' nitrogen (^{15}N). Bacteria are grown in a liquid in separate test tubes containing 'light' or 'heavy' nitrogen. As the bacteria reproduce they absorb nitrogen from the liquid in the test tubes.



[Adapted from *AS level Biology Exam Board* – OCR The Revision Guide]

1.2.5 Nitrogen can be used as a marker in this experiment as it is …

A an element found in all organic molecules.
B an element found in DNA bases.
C found in the membranes of bacteria.
D found in deoxyribose sugars.

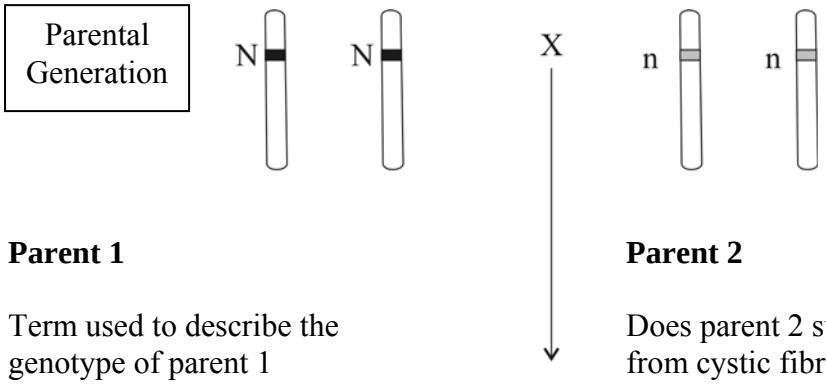
1.2.6 This experiment shows that when DNA replicates …

A two entirely new DNA strands are formed.
B the DNA strands formed have half of the original DNA components and half new components.
C the original DNA strands reorganise themselves to form new strands.
D the 'heavy' and 'light' nitrogen enables protein synthesis to take place.

1.3 Cystic fibrosis is a human disease caused by a faulty (mutant) gene on chromosome 7.

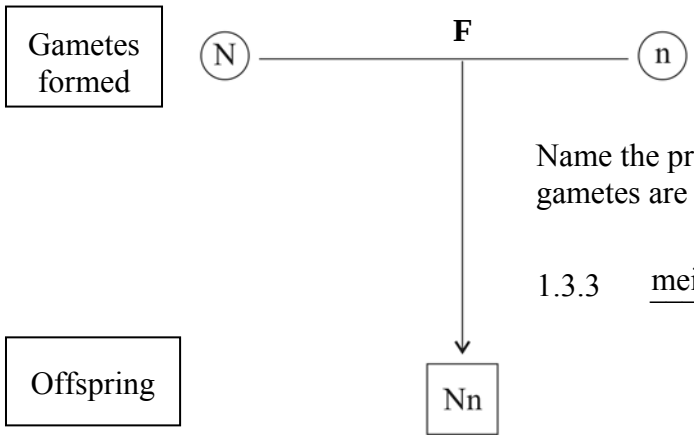
Fill in the answers as required on this diagram.

The gene for the normal condition (no disease) is represented as N.
The gene for cystic fibrosis disease is represented as n.



1.3.1 homozygous (1)

1.3.2 yes (1)



1.3.3 meiosis/ reduction division (1)

Describe the genotype and phenotype of the offspring

Name the generation represented by the offspring

1.3.4 genotype heterozygous/ Nn (1)

1.3.6 1st filial/ generation/ F1 (1)

1.3.5 phenotype no cystic fibrosis/ normal/ no disease (1)

1.3.7 Mark with an F the point on the diagram which represents fertilisation. (1)

1.3.8 One of the offspring reproduces with a person with the same genotype. Give a ratio of the possibility of whether their children will suffer or not suffer from cystic fibrosis.

✓ ✓

1 suffer : 3 non suffers (2)

1.3.9 Use information from the processes shown on the previous page (in the genetics diagram) to explain why the ratio you have given in the question 1.3.8 is a probability and not an accurate prediction.

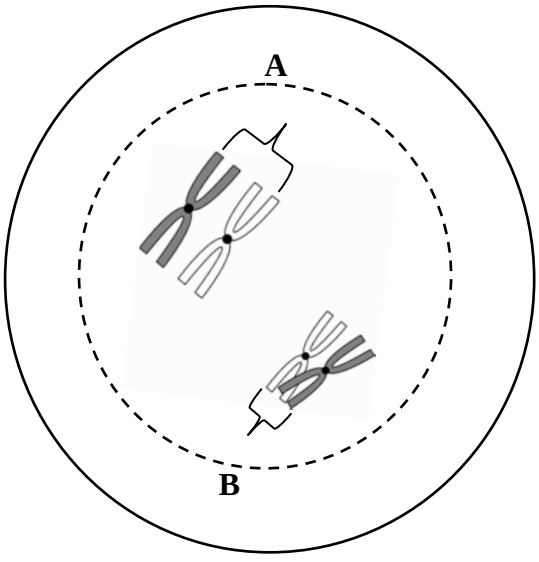
Gametes formed by meiosis, ✓ variation occurs during this process. ✓ Each daughter cell produced differs genetically from others.

Depends on which gametes fuse ✓ or which egg and sperm fuse. ✓

any (4)

13 marks

1.4 **Diagram to show an animal cell during meiosis.**



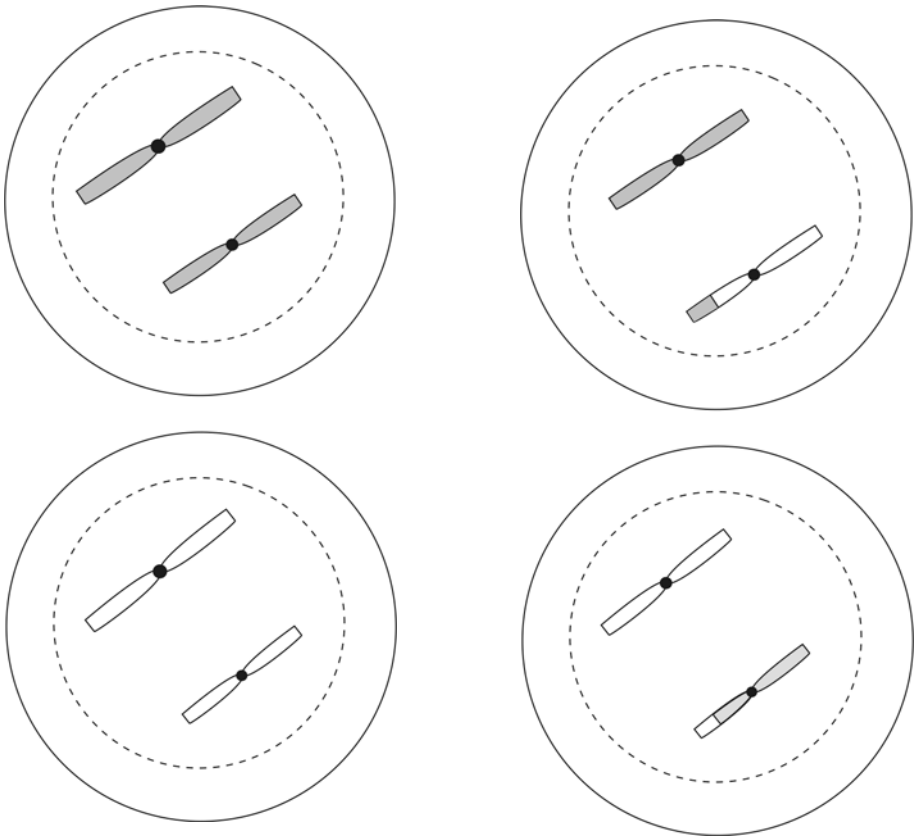
1.4.1 Would you see the structures A and B as shown in the diagram above, with the naked eye, or with a microscope?

microscope ✓ (1)

1.4.2 Name the pair of structures at A homologous chromosomes ✓/ bivalents (✓)

and the process taking place at B crossing over (✓) (2)

1.4.3 Here are two of the cells that could result from the animal cell shown in 1.4 at the end of meiosis. Draw the remaining cells in a similar fashion. **Do not include labels.**



Marks for drawing 2 cells ✓✓
2 chromosomes in each ✓✓
correct shading of chromosomes in each ✓✓✓✓

(8)
[11]

QUESTION 2

2.1

2.1.1 Reproduction in which new individuals are formed ✓ from a single parent ✓/ no fusion of gametes. ✓ (2)

2.1.2 Farmer can use the potatoes/ tubers ✓ or part of them, to produce more plants ✓ which make food ✓ stored in new tubers. ✓ This is evident as the potatoes have got buds/ eyes ✓ on them and each of the buds ✓ can grow into a plant. The one potato plant shown has several tubers, ✓ each of which can produce several plants. (any 4)

2.1.3 One example of an answer:
Hypothesis: Farmer B's potatoes are more nutritious than farmer A's, as the genotype is different ✓ or other example/ can also state environmental factors cause the difference.
Aim: Experiment to prove that a difference of genotype causes a difference in the nutritional value potatoes A and B. ✓
Method:
(a) Harvest the same number ✓ of potatoes from A and B fields at the same time. ✓
(b) Plant these potatoes in a new field, under the same conditions, ✓ e.g. soil, light ✓ and allow the potatoes to grow into new plants. ✓
(c) Harvest the potatoes that form on these plants. ✓
(d) Test the potatoes for the presence and amount of nutrients, e.g. proteins/ starch/ vitamins/ minerals. ✓
(e) If there is a difference it is due to genotype as the environmental factors were the same.✓ (2 + 6 = 8)

2.2

2.2.1 Mitosis ✓ as it is one of the body cells not a gamete. ✓ (2)

2.2.2 (a) ovary ✓ (1)
(b) uterus ✓ (1)
(c) to produce milk ✓ to feed lamb (1)

2.2.3 It does not result from the fusion of two gametes, ✓ diploid nucleus inserted ✓ the cytoplasm from one sheep and the nucleus from another, ✓ genotype is identical to the one parent ✓/comes from two female sheep. ✓ (3)

2.2.4 Lambs would have a predicable genotype, ✓ this could be one with good genes for wool or meat ✓ the surrogate mother can also be selected for safely producing lambs, ✓no rams needed ✓ farmers can select which sheep to breed from. ✓ (4)

2.2.5 One example of an answer.
It is unnatural ✓ male sheep not fertilising eggs ✓ no natural variation can be introduced ✓ which might be beneficial. ✓
If large environmental changes, ✓ e.g. weather, no variation to cope ✓ with this. (4)

30 marks

QUESTION 3

3.1

3.1.1 **Shape** of sperm (show head, neck, tail ✓) Draw in **large** nucleus ✓ **mitochondria** ✓ or fibrils ✓
3 marks for labels; head ✓ neck ✓ tail ✓ nucleus ✓
mitochondrion ✓acrosome ✓ any 3 (6)

3.1.2 Haploid ✓ produced by meiosis as sperm fertilises egg ✓ and the diploid state is restored. ✓ any (3)

3.2

3.2.1 Epididymis ✓ (1)

3.2.2 High sperm count is decreasing ✓ 50 to 15% ✓ low sperm count is increasing ✓ 5 to 18% ✓/fertility ✓ is decreasing. ✓ (4)

3.2.3

(a) Sperm production varies with age, age of men in sample should be a constant ✓ and not a variable. ✓/same age ✓
(b) Another variable could be health of men ✓ many diseases ✓ could also be a variable, what does 'normal' mean?/no diseases ✓
(c) Conditions around the collection and counting of the sperms could also be a variable ✓ laboratory techniques could have advanced from 1930 to 1990 ✓/ same experimental techniques should be used. ✓
(d) More information is needed about the population, ✓ only 55% counted in 1930, what is the sperm count of the rest? ✓
Other reasonable answers will be considered. (8)

3.2.4 (a) Stimulate the production of ova in the ovary ✓ or other correct answer. (1)

(b) These substances are absorbed into her body ✓ could circulate in her blood ✓ and across the placental wall ✓ in the male foetus, which could damage the development of the testes ✓/ male sex organs. any (3)

(c) Feedback to control the production of FSH and LH or pituitary hormones ✓ control of development of follicle, ✓ repair and growth of endometrium ✓ as oestrogen levels increase ✓ increasing levels lead to growth of mammary glands ✓ and other secondary sexual characteristics ✓ or increasing levels of oestrogen lead to ovulation ✓ or other correct answer indication how changing level of hormone has a resultant effect on body. (any 4)

30 marks

QUESTION 4

4.1

4.1.1 Market demands ✓ the modified cabbages as they are easier to cook/ more attractive to people buying them or similar answer ✓ selective breeding could result in more nutritious cabbages ✓ as nutrients could be stored in buds, ✓ etc. (3)

4.1.2 Yes ✓ Plants of the same species ✓ by definition can breed ✓ therefore same number of chromosomes. (3)

4.2

4.2.1 Cells are undifferentiated/ result from uncontrolled cell division ✓ that can cause tumours. ✓ (1)

4.2.2 Gene is a portion of a chromosome ✓ consists of a linear sequence of nucleotides ✓ order ✓ important in the determination of the protein/ polypeptide ✓ as a sequence of amino acids. ✓ any (4)

4.2.3 The DNA strand unravels ✓ bonds between the base pairs are broken ✓ one side of the strand is transcribed ✓ to form mRNA ✓ travels to ribosome where amino acids are assembled ✓ in the sequence determined by the mRNA as tRNA delivers the specific amino acids ✓ during temporary bonding between the bases on the mRNA and tRNA strands. ✓ (7)

4.3

4.3.1 Plant formed from cells in which the genetic structure ✓ has been altered ✓ by the introduction of a plasmid/ ✓ with 'good' genes/ genetically engineered. ✓ (any 2)

4.3.2 (–2 if sequence is incorrect)
'good' gene inserted ✓ → into plasmid of soil bacterium ✓ → plasmid introduced into plant tissue ✓ → plant tissue stimulated ✓ → transgenic plant formed ✓ (any 4)

4.3.3

Use of contents of extract	[3] Shows full understanding of formation of transgenic plants and their resistance to crown gall disease, e.g. isolation of infected plasmid, gene removed and replaced, plants grow from tissue.	[2] Incomplete understanding of formation of transgenic plants and their resistance to crown gall disease, but reference to both.	[1] Answer illustrates little understanding of the formation of a transgenic plant or disease resistance. Fleeting reference to one of these topics.
Ability to put forward a motivation	[3] Reference to fruit farming and influence of crown gall disease on fruit, practical use of transgenic plant suggested, reference to economic benefits, e.g. guaranteed disease free crop, less chemicals required.	[2] One of these aspects missing or poor motivation.	[1] Two of these aspects missing or little evidence of an understanding of a motivation.

(6)

30 marks

QUESTION 5

	0	1	2	3	4
Making a decision 2	No decision made.	Undecided.	Clear decision made as to whether to have a second child.		
Substantiation: Fairness 3 Acknowledge other opinions	No reference to other possibilities/ choice.	No or fleeting reference to other possibilities/ choices.	Evidence that other possibilities/ choices exist but only short-comings of other viewpoints, e.g. has not presented no child option fairly.	Evidence that other possibilities/ choices exist, recognition of other views having merit, e.g. no child as chance of disease despite interventions, possibility of abortion.	
Substantiation: Thoroughness 4 Content	Response is entirely opinion with no supporting evidence.	Very little actual evidence cited in support of opinion.	About half the possible information was cited, and some instructions missed.	All main topics fulfilled though importance/ significance of some information missed. Other information if present, is not integrated.	Information cited close to full potential; all main 'topics' fulfilled. Evidence of information or reasoning beyond the sources that is integrated in the response, e.g. reference to recessive gene, types of early detection and risks, counselling accuracy, has also weighted up effect on child and modern treatment options.
Substantiation: Relevance 4	Source information, where given, is unprocessed.	Digression to the point where question appears to be ignored or at least 2/3 of the topic is irrelevant.	Loss of relevance to the point where discussion digresses from the topic for perhaps a paragraph.	Loss of relevance to the point where one or two sentences spent on the digression.	No or incidental (mere comments) loss of relevance. All facts given provide focused support of the decision made.
Argument, depending on accuracy: 4 Construction of argument	Argument, where given, is unprocessed.	Writing consists of facts with little linkage or reasoning.	Arguments and reasons are clear on average (approximately 50:50).	Some unclear/ incorrect reasoning that detracts from the quality of the response.	Argument in support of decision to have a child or not is mostly logical, the reasoning clear, and generally persuasive.
Presentation: 3 Scene setting Argument Wrap up		No paragraph breaks, scene not set and little wrap up.	Physical but inappropriate paragraph break, introduction does not catch interest.	Paragraphs divided clearly on unified theme not than just physically, scene set and sound 'wrap up'.	

20 marks

Total: 150 marks